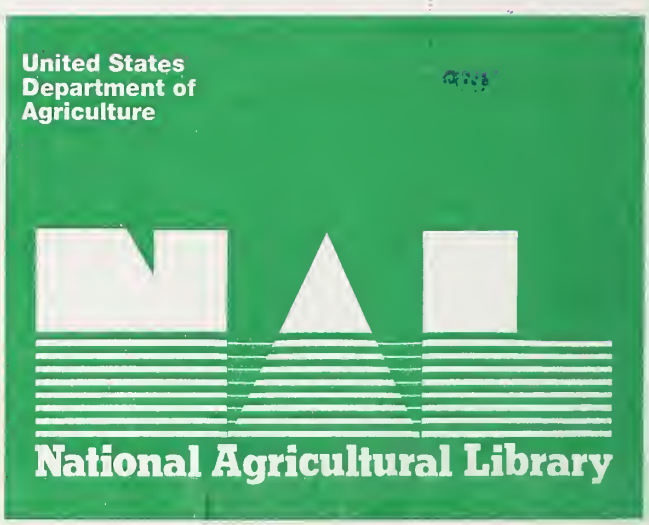
YOUR WOOD CAN LAST FOR CENTURIES

Forest Service
U.S. Department of Agriculture

This publication is part of the U.S. Forest Service information program designed to make forestry research on protection of wood in use more understandable and usable for practitioners and laymen.

The information and illustrations in this booklet relate research findings at the Southern Forest Experiment Station and at the Forest Products Laboratory to practical problems of wood protection.

Rodney C. DeGroot, former plant pathologist with the Southern Forest Experiment Station, is now associated with the U.S. Forest Products Laboratory, Madison, Wisconsin.



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YOUR WOOD CAN LAST FOR CENTURIES

by Rodney C. DeGroot

Forest Service
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How's Your House?

SOME HOUSES built of wood endure for centuries; yet others develop decay problems soon after construction. Why? Because wood is a biological material. Used properly, it doesn't deteriorate. Misused, it succumbs to the same biological processes that decompose dead trees in the forest. In other words, it may be rotted by fungi or eaten by termites and other insects. In the forest, decomposition serves a worthwhile purpose, but to the homeowner it means a repair bill.

This booklet explains why wood decays. It will alert you to the conditions that create decay hazards in buildings so you can prevent future damage in your current home or planned construction. As you will find, simple procedures often provide remarkable protection. Other times, more drastic repairs are needed. But whatever the damage, it will only get worse until you find the fault and correct it.

This is the Henry Grady House, built circa 1840, in Athens, Georgia. The warm high-rainfall regions of the South are conducive to wood decay. Nonetheless, centuries-old houses still stand.

The Baldwin House, Arcadia, California, built in 1875.

The Parson Capen House was built in 1683, in Topsfield, Massachusetts. A building design and construction detail that do not allow water to collect are fundamental features which contribute to almost three centuries of service by this house.

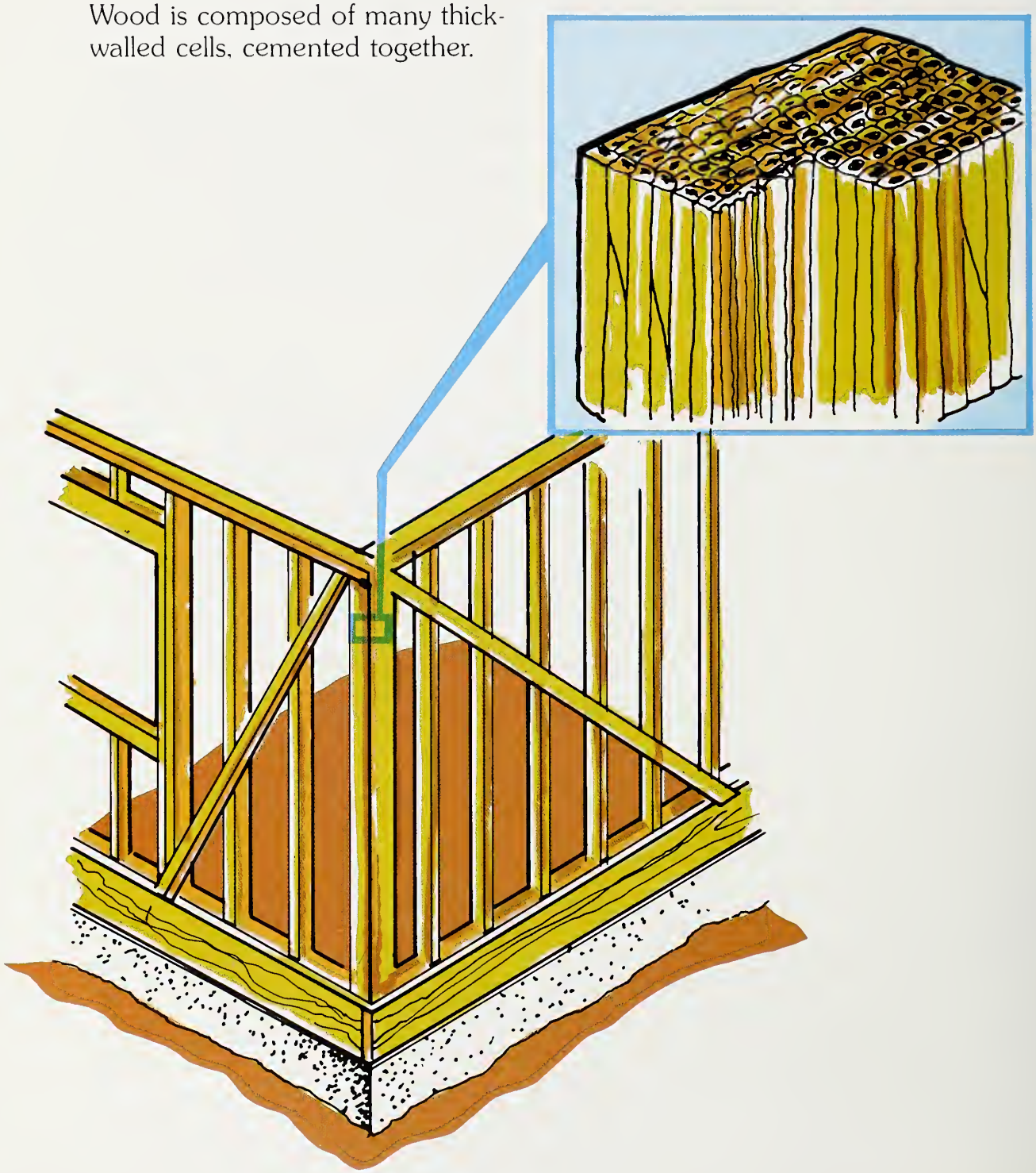
Jonathan Ashley House, Deerfield, Massachusetts, built in 1730.

Fairbanks House, Dedham, Massachusetts, circa 1637. Probably the oldest frame house standing in the United States.

The Marrs Log House near Harrodsburg, Ky. was built in 1730.

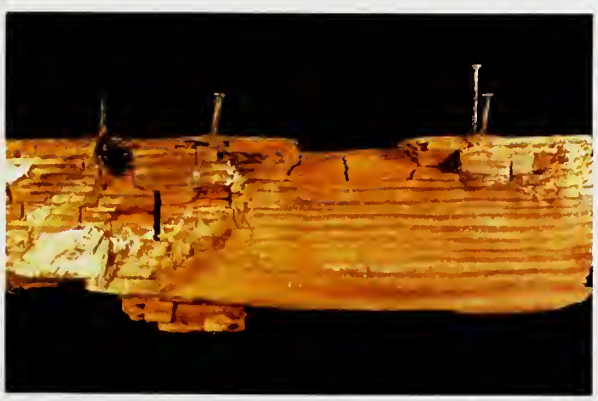
What is Wood?

Wood is composed of many thick-walled cells, cemented together.

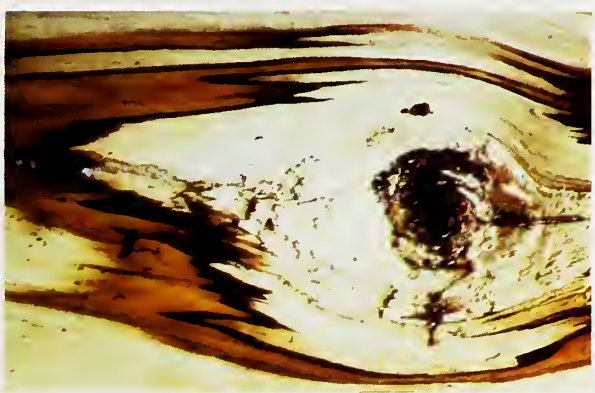


What is Decay?

First, it's important to know that water and the elements do not decay wood by any direct action on their part. Decay is caused by microscopic, thread-like fungi which move into the wood and attack its thick cell walls. Given the necessary environment of moisture and air to thrive, these fungi in time will destroy enough cell walls to weaken the wood.



Some fungi cause a brownish discoloration, in which case the wood readily breaks into small cubes. This is called BROWN ROT.



Other fungi produce a bleached appearance which may be surrounded by very dark lines of discoloration. This is known as WHITE ROT.

What is Decay?

continued

When decay is well advanced, the fungi produce fruiting bodies on wood. These are the reproductive bodies. They produce spores (like seeds of flowering plants) which, when released, are blown about by the wind. If they alight on moist wood, they may germinate and start another decay process.

Fungi Need Water and Oxygen to Survive.

Decay fungi need at least a trace of water on the surface of wood cell walls to grow. Without water, decay can't occur. Thus, buildings should be designed to minimize the wetting of wood or to expedite the drying of wood when wetted by rain.

The cliff dwelling ruins at Kiet Siel in northern Arizona (below) date back to the 13th century. Dwellings in this semi-arid region are further sheltered from occasional precipitation by cliffs overhead. Wood beams and superstructure have remained sound for centuries because they have always

been too dry to decay.

As with most living organisms, fungi require oxygen to live. When wood is submerged in water, for example, air is driven out of all the cells and decay fungi can't grow.

Below is the lower deck of the WASA which sank in the harbor of Stockholm, Sweden in 1628, and remained there until the 1960s. Submerged under water for over 300 years, wood in this ship remained intact because there wasn't enough oxygen to permit growth of wood decay fungi.

If Wood Can't Be Kept Dry

The best way to prevent wood decay in houses is to protect the wood from excessive moisture. But sometimes wood must be used where it will be continually wetted. In such cases, use wood that resists decay:

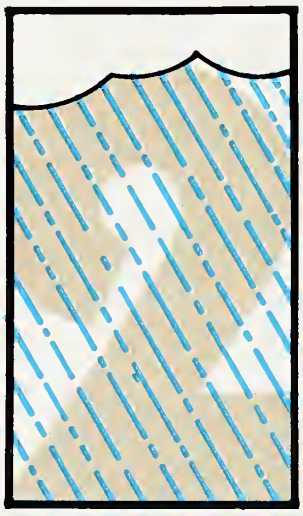
Preservative-treated wood. Pressure treatments force wood preservative chemicals into the wood. Such treatments are designed either for use in the ground or for use above ground. It's important that you specify the right treatment for your specific need. In addition, insist that the treatment be of certified quality and that the treated wood is labeled accordingly.

For some uses, pressure treatment is not necessary. Assembled millwork items such as window frames and sash are usually sold already treated with a water repellent preservative. This treatment doesn't penetrate deeply into the wood, but it prevents decay by retarding water absorption. The repellent also contains a small amount of preservative to prevent fungal growth.

Naturally decay-resistant wood. Heartwood (wood in the central part of the tree trunk) of several tree species is naturally resistant to some decay fungi, and is suitable for some uses. California redwood and western red cedar are the principal decay-resistant woods used in construction today.

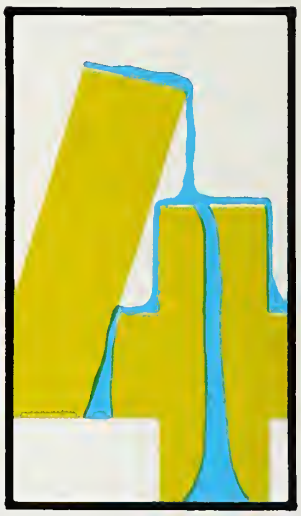
8 Chief Sources of Moisture Leading to Wood Decay

SOIL CONTACT

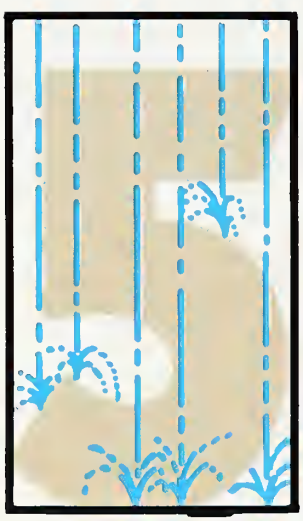


FREQUENT RAINS

RAIN SEEPAGE

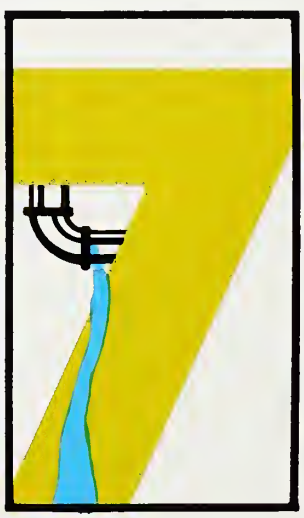


WATER FLOWING OFF THE ROOF

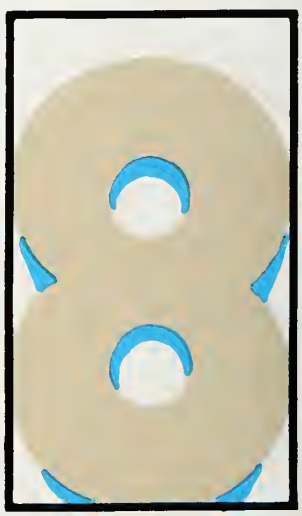


SPLASHING RAIN

WATER COLLECTING AGAINST WOOD



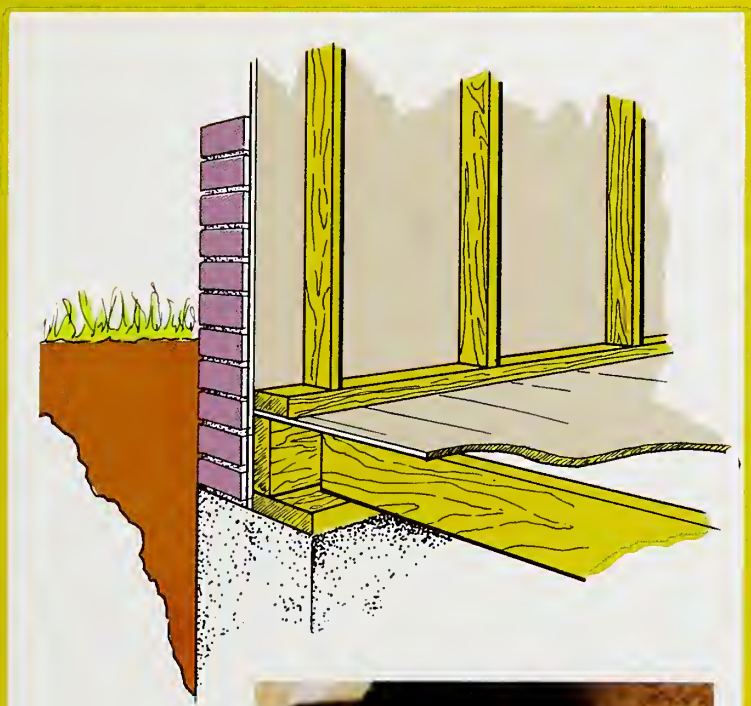
PLUMBING LEAKS

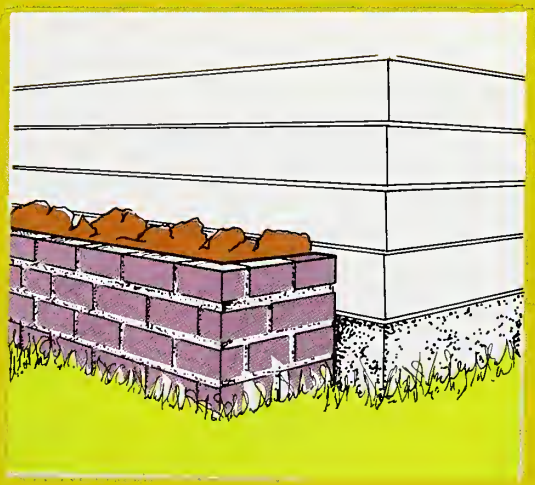


CONDENSED MOISTURE

Soil Contact

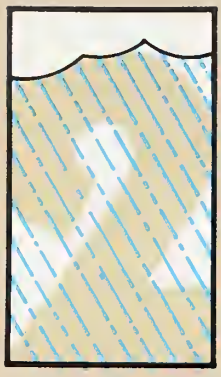
Soil usually provides a continuous source of moisture for decay fungi. This is sometimes forgotten when new rooms are added, flower beds made, or the lawn graded. If wood in permanent structures is to be used in contact with the soil, it should have a preservative treatment approved for ground contact. Wood so treated has a greater resistance to soil fungi than do naturally decay-resistant woods. If untreated, wood should be at least 8 inches above adjacent finish grade for framing members and 6 inches above finish grade for siding.





When flower beds are made next to the house, too often the soil is piled so high that it touches the wood siding. This will lead to decay in a short time.

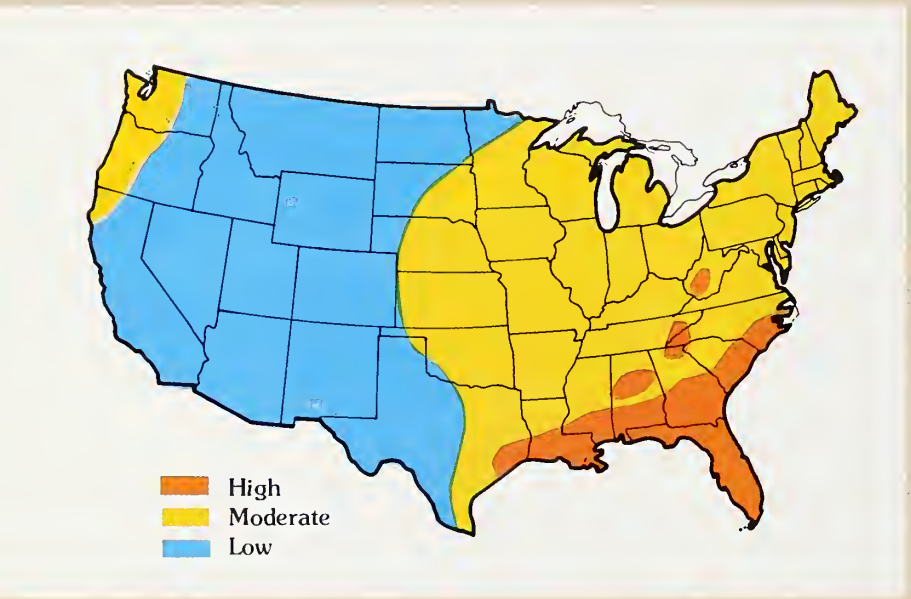
Soil graded high against the exterior brick veneer will contribute to decay problems in untreated wood members below the grade line.



Frequent Rains

The natural hazard for decay of wood used above ground is greatest in regions of high rainfall and mild climate. In the contiguous United States, this occurs in the Southeast and in the Northwest.

The decay hazard for houses is greatest on the side that is exposed to the prevailing rains. This is most noticeable in the region of highest decay hazard, where greater precautions against decay may be needed on the more exposed side of the house than elsewhere.



Three zones of decay hazard.

But remember, persistent wetting of exterior wood with a lawn sprinkler artificially creates a high decay hazard, even in a low-hazard region.

Rain Seepage

Decay sometimes occurs only where boards or beams are joined together (end to end), while the rest of the wood structure remains sound. One reason is that water gets trapped in the joints. Also, the ends of boards or beams absorb water much more rapidly than do the sides. This happens because of the arrangement of wood cells.

In the living tree, these cells conducted water up the stem. Because they were oriented lengthwise in the stem, they are similarly oriented lengthwise within boards and timbers cut

Water running around roof edges and onto wood below is absorbed most rapidly at cut ends of wood trim and beams. Hence, paint failure and decay begin at these points.

Rain Seepage

continued

from the tree stems. Each of the many thousands of these cells, which are exposed at the cut ends of boards, functions somewhat like a soda straw. Water moves much more rapidly up through the length of each cell than it does through the thick walls. Hence, water is absorbed rapidly from the ends of cut timbers, but only slowly through the sides.

In thin wood materials such as exterior siding or facia boards at the edges of roofs, water is absorbed mostly through the ends. In larger beams, however, water is absorbed two ways: through the ends and through small checks in the upper, weathered surface which collect water during each rain. As the wood wets, it swells and the checks close; hence drying is retarded. Similarly, exposed beams, comprised of several

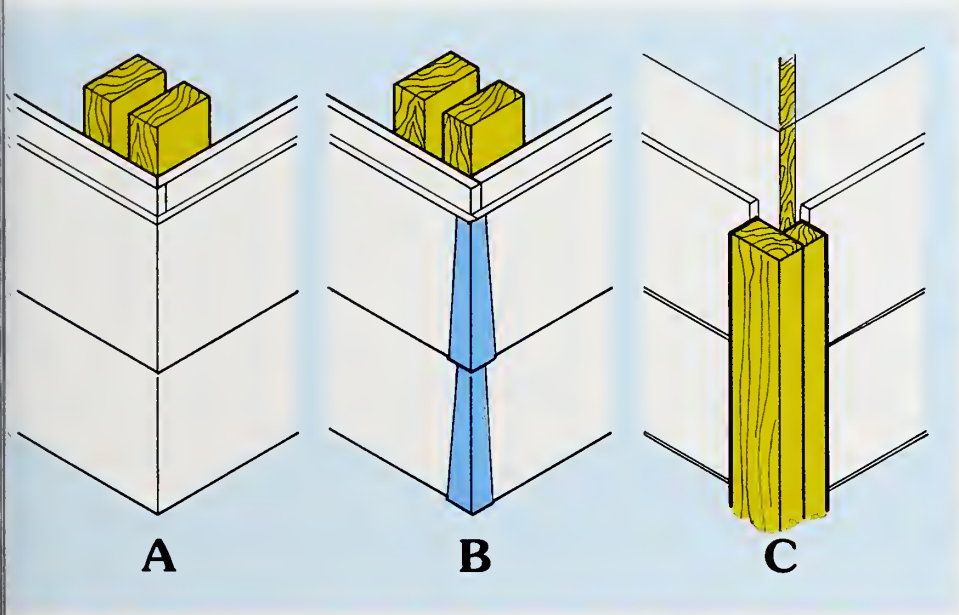
Cracks that open as wood dries out permit serious rain-wetting of central portions of large beams. In regions of high decay hazard, beams that are exposed to weather should be preservative-treated.

A small metal cap on top of this exposed beam did not provide adequate protection from wood decay in a high rainfall area. Rain was absorbed both through the ends and between the individual timbers that comprise the beam. Serious decay is evident by fruiting bodies of decay fungi growing from the end of the beam.

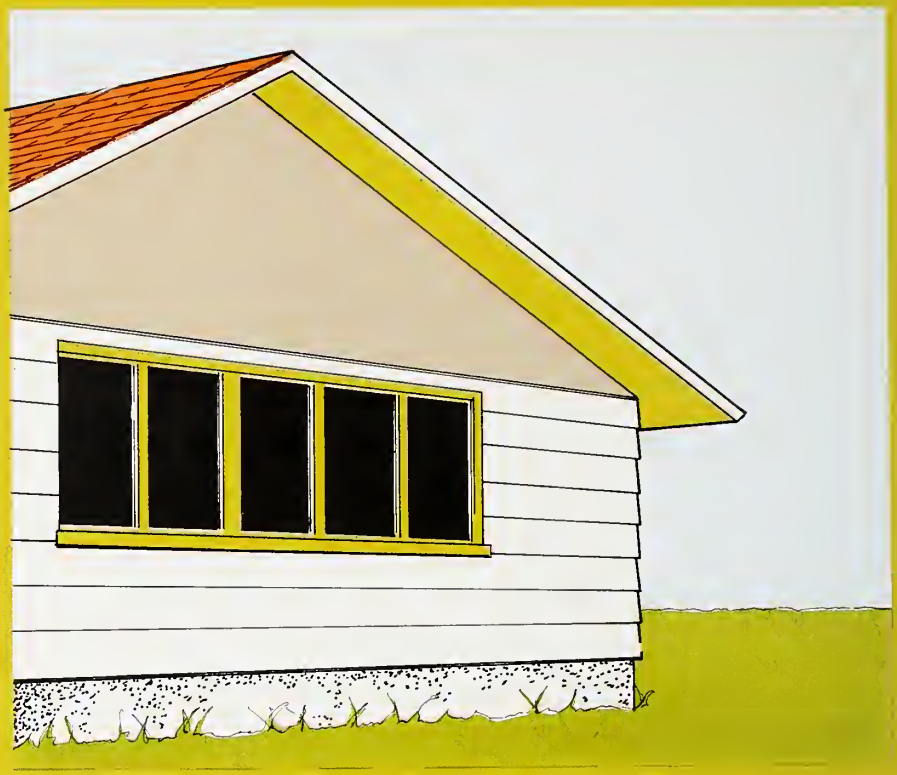
layers of smaller timbers nailed together, may be wetted by water that creeps in between each layer. This moisture, which dries slowly, contributes to a decay hazard. Large, load-bearing timbers that are exposed to weather should be preservative-treated. Their top surfaces should be flashed to prevent water entering through checks.

Absorption of water at the ends of siding is most important in the high decay hazard zones, especially where storms come predominantly from one direction. Butting siding against a vertical trim provides maximum opportunity for rain seepage into the siding. Capping the ends of wood siding with metal corners provides excellent protection against end-grained absorption.

Sash, door and window frames that are made of a decay-resistant wood or preservative-treated wood are commercially available. Check carefully before you buy.



Caps over the siding at building corners (B) provide greater protection against water absorption than mitered (A) or butt joints against a vertical edging strip (C), which permit excessive absorption of water.



A wide roof overhang moves the water runoff from the roof away from exterior walls. The splash zone is also moved farther from the building base.

Serious problems occurred in the roof of this house because flashing was not used between roof and dormer.

Proper flashing insures a tight roof and prevents decay problems.

Water Flowing Off the Roof

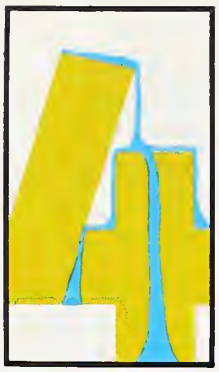
Many wood decay problems are caused by roof construction that doesn't allow rain to move off the roof and away from the house.

In some houses, water flow over the roof is interrupted by chimneys, dormers, or adjoining walls. Such areas of concentration need flashing to make the roof watertight. Even slight leaks can produce serious decay problems because a large supply of water is available with each rain, and wood wetted by the leak has little opportunity to dry rapidly. Adequate flashing should be installed in such areas.

Wood trim at the edge of the roof is continually exposed to moisture and is prone to decay, particularly in the area of

Decay results when water from low-pitched roof drains over wood below. Decay appears first in places where wood is joined together, due to end-grained absorption.

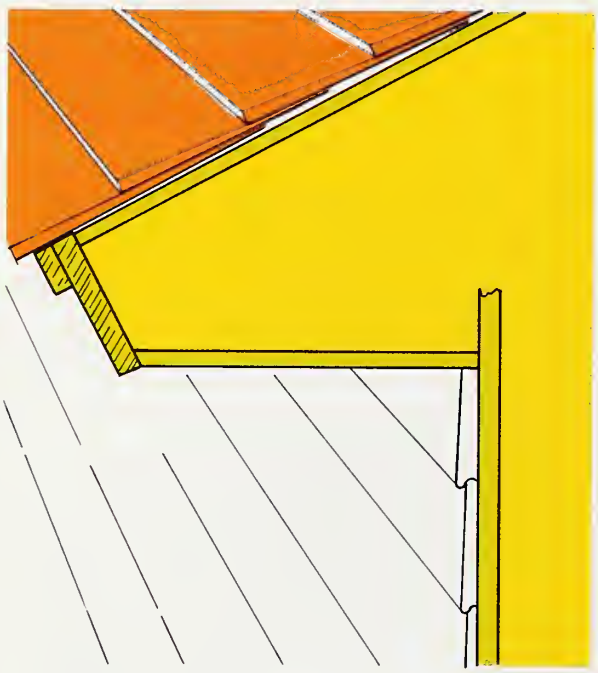
Runoff from the lower roof flowed against the joists (arrow) supporting this porch roof. Water creeping between the individual timbers of the joist promoted a serious decay problem which extended into the house proper, even affecting the ceiling over the bedroom behind the front wall.

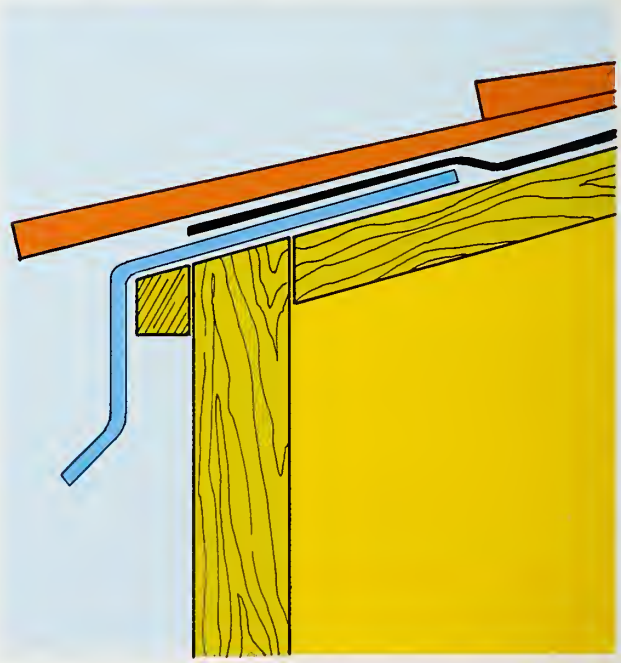


Water Flowing Off the Roof *continued*

If shingles don't extend far enough beyond facia board, water that curls under the shingle will drain over wood trim at roof edge. This leads to paint failure and decay. ▶

high decay hazard. Water tends to curl under the shingles and flow back towards the trim. Thus, shingles must be extended far enough over the edge and metal edgings must be carefully positioned so that water dripping from the roof will clear the trim. Leaking and overflowing rain gutters further wet the trim. Homeowners should keep rain gutters open and in good repair. In the high decay hazard areas, use of decay-resistant or preservative-treated wood for roof trim is recommended. This is especially true for roofs with low pitch.





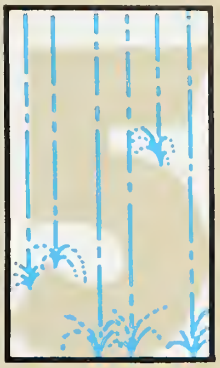
Several approaches can minimize this problem:

Use preservative-treated wood in roof trim.

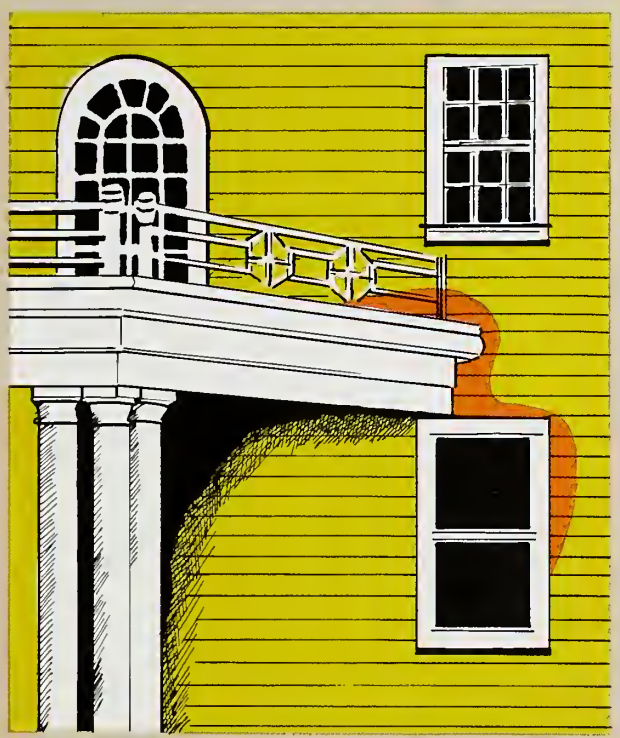
▲ *Install facia board at right angles to slope of roof.*

Extend shingles far enough ▶ *beyond roof edge and install metal edging so that drip line from roof will clear wood trim.*

Splashing Rain

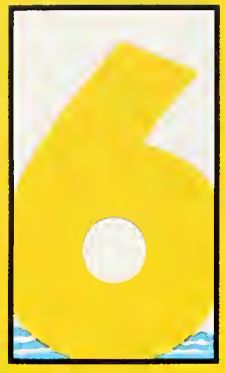


Water that flows off the roof and splashes against the house may also wet wood enough to permit decay. This problem occurs especially where water flows from the roof onto a hard-surfaced patio, entryway, or sidewalk parallel to the house. Sometimes this hazard is increased inadvertently through the use of small diverters over doorways. If the stream of water draining from the diverter flows or splashes against exterior woodwork, wood that otherwise could provide satisfactory service may decay. Usually, this hazard can be prevented through careful design of house and entryways and through appropriate use of treated wood products at the time of construction. In existing housing, rain gutters should be installed with downspouts that direct the drainage away from the house.



Water that flows against siding as it drains from lower roof causes excessive wetting of siding. This leads to paint failure and decay.

Water draining from lower roof will contribute to a decay hazard (1) where it drains against siding and (2) where it splashes against siding at base of wall.



Water Collecting Against Wood

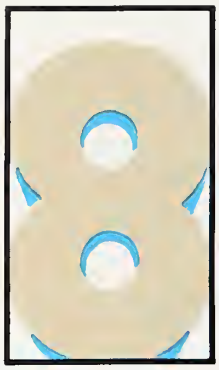
Drainage from the roof and rain that collects on the hard surface of a porch, carport slab, or sidewalk present another decay hazard.

Decay problems arise in bases of porch posts and garage door jambs that rest directly upon sidewalks, driveways, or porch slabs. Especially in regions with a high hazard for decay, bases of wooden posts need protection. Use naturally decay-resistant or preservative-treated wood. Otherwise, be sure that roof runoff is directed away from these structures and that the posts do not touch the hard surface.

This porch surface slopes toward the house. Water flowing against the house contributed to serious decay in exterior siding and in subfloor joists.

Plumbing Leaks

Obviously, wood that is wetted continuously by faulty plumbing will decay. Spillage behind a washing machine, leaks at the top of a built-in tub, or leaks in a shower stall may go unnoticed for a long time. If so, they can lead to a serious decay problem in the floor and lower parts of interior walls. Annual inspections and minor home maintenance can prevent this type of problem.

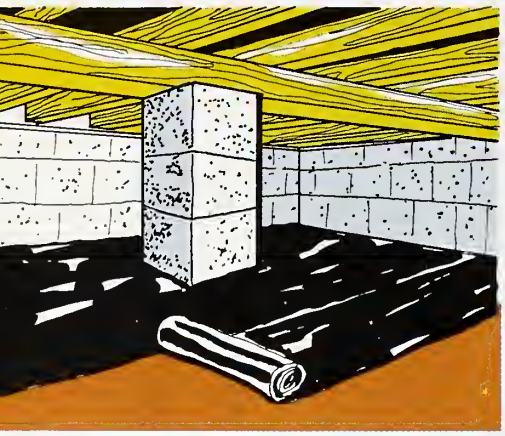


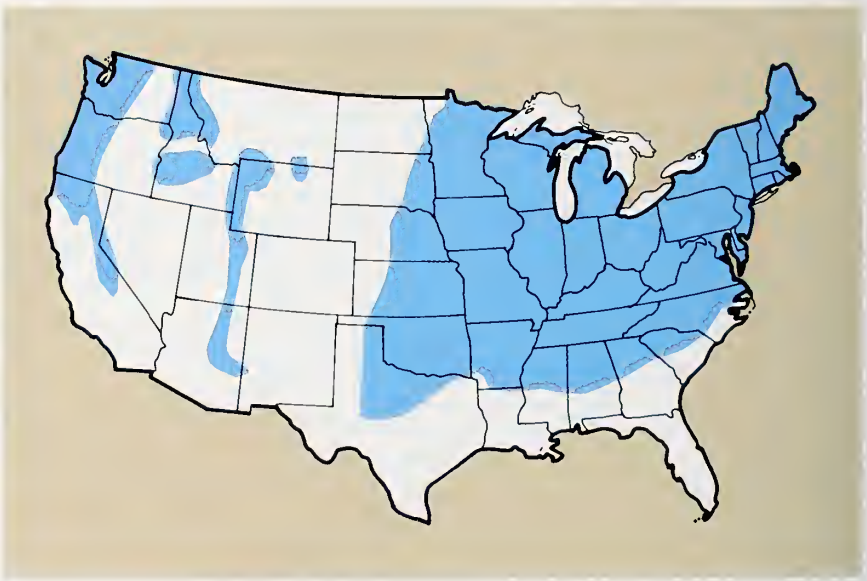
Condensed Moisture

Many houses are built over an enclosed crawl space. If ventilation is poor or if the soil is particularly moist, condensation problems can develop in the floor. This is particularly true in some regions (see map). The hazard is accentuated when vents in the perimeter walls are closed in the winter. During the cooler months, moisture from the soil beneath the house condenses on subfloor timbers, which become wet enough to decay. If condensation is left unchecked, sills and joists can rot out in 5 to 15 years. But this problem can be prevented by placing a vapor resistant covering, such as heavy roll roofing or a polyethylene sheet, over the soil in the crawl-space area. Where soil covers have been used, closing the crawl-space vents to conserve heat has not created condensation problems.

Not all houses need a soil cover, nor will such a cover be effective against improper surface drainage. A soil cover does little good under a house if water collects on top of the membrane.

Condensation on joists of floors over enclosed crawl space can be controlled by covering the soil with a vapor barrier.





Climatic conditions are apt to cause condensation during winter months in some sections of the country. Ground covers are recommended for houses with enclosed crawl spaces in the dark sections shown here.

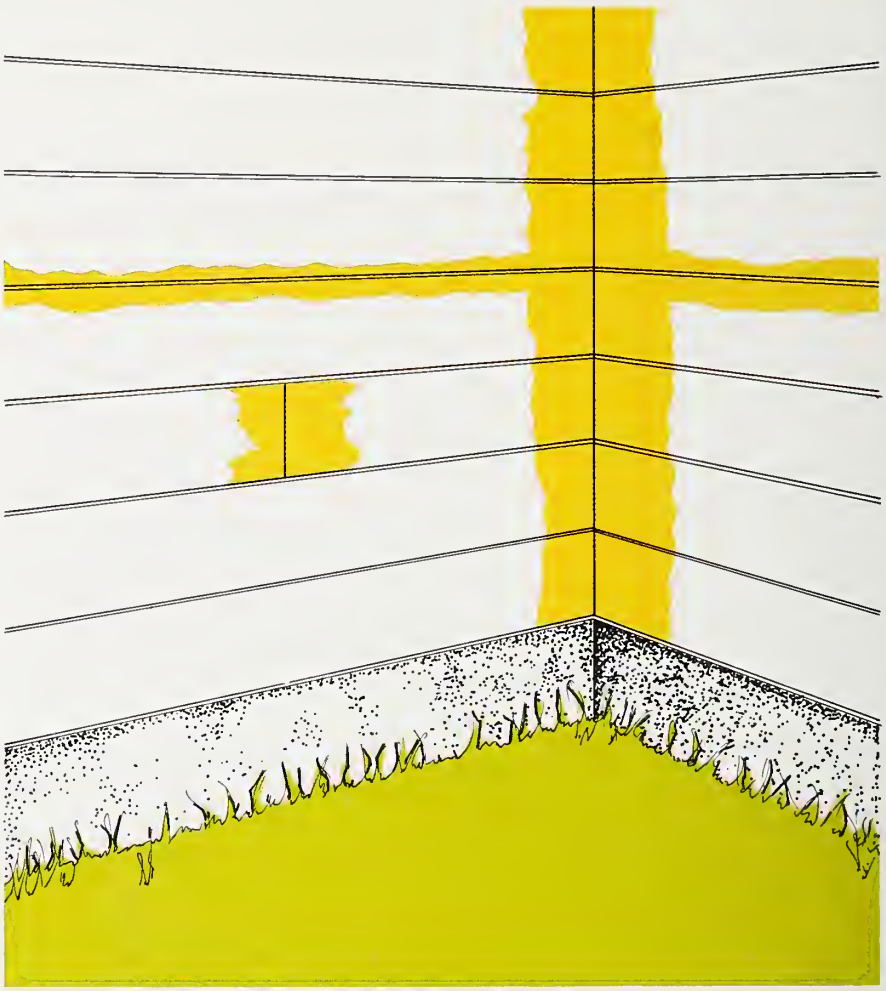
Water-conducting Rots

A water-conducting rot started in this house when an infected beam, resting on the ground, was used to support joists above.

All wood decay problems described thus far occur only in wet wood. But one kind of fungus is uniquely capable of transporting its own water from a source of moisture (usually the soil) into wood that is otherwise too dry for decay to occur.

Decay by water-conducting fungi is uncommon but, when it occurs, it's devastating. Large areas of flooring and walls can be destroyed each year unless the fungus is stopped. Ironically, this is perhaps the easiest type of decay to prevent or to control, once it starts. Unlike typical decay fungi which start from air-borne spores, water-conducting fungi usually start from already infected lumber that forms a bridge between soil and other wood in the house. This can happen when old, discarded beams that have been lying on the ground are used in home repairs or additions. Likewise, infected wood sometimes is inadvertently included in fill for hollow porches. Active attacks can be stopped by breaking the contact between susceptible wood and the source of moisture. Once the water supply is broken and the infected wood allowed to dry, the fungus will die.

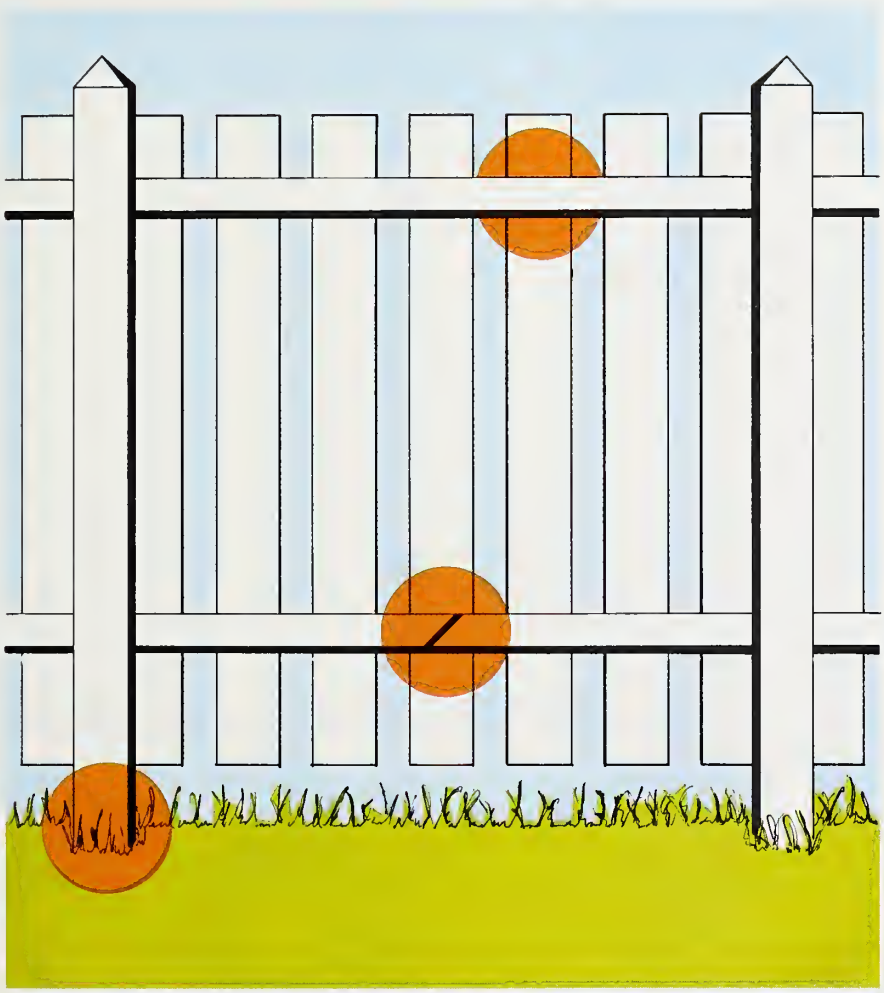
Does Painting Protect Wood from Decay?



Keeping the paint seal at wood junctures intact is all-important. These are the points where moisture creeps into the wood most readily.

Coatings that form a moisture-impervious film are effective in preventing decay if the seal where wood units are joined together is kept intact. A well-maintained film of paint over the wood and good paint seals in the joints shed water, thus protect wood by keeping it dry. But if paint seals permit entry of water, moisture-impervious coatings contribute to decay. Water seeping through the broken seals where wood is joined together will be rapidly absorbed at the ends of the wood pieces. Its loss by evaporation from the sides of the wood member is retarded by the impervious, intact paint film over the rest of the wood. This keeps the wood moist and favors decay, at least near the joints. Thus, the effectiveness of a moisture-impervious paint in protecting wood from decay depends upon the quality of the seal in the joints.

Wood Fences



The same principles of decay that are applicable to buildings also apply to wooden fences.

The greatest decay hazard exists at the ground line. For posts, either wood pressure treated for ground contact or naturally decay-resistant wood may be used in the region of low decay hazard. Elsewhere, pressure-treated wood approved for use in the ground is recommended.

A lesser, but still important, decay hazard exists where horizontal rails are joined together and where vertical boards fasten to the rails. Both of these locations collect water and dry slowly. Use naturally decay-resistant or preservative-treated wood for horizontal rails.

Keep vertical boards off the ground. In a high decay hazard area, use pressure-treated wood or naturally decay-resistant wood.

What Can Be Done to Promote a Long Service Life from Wood?

1

Recognize the conditions that present a decay hazard for wood.

2

When new construction is planned, protect wood from moisture and decay hazard by proper design.

3

For above-ground uses where wood cannot be protected from excessive moisture, use decay-resistant wood (natural or treated). However, large exposed load-bearing beams should be preservative-treated.

4

Where wood in permanent structures is in contact with the soil, use preservative-treated wood that is approved for ground contact.

5

When decay is detected, take corrective actions to stop wetting of wood. Otherwise, decay will only get worse!

6

Contact professionals for additional advice.

For over 75 years, the U.S. Forest Service through its 8 regional research stations has overseen forestry research programs aimed at protecting, managing, using, and replenishing our forest resources.

Besides such research, the Forest Service cooperates with state agencies and private forest owners to stimulate proper management practices and to protect the 440 million acres of their forests against fires, insects, and diseases.

The Forest Service also manages 187 million acres of public land, including 154 National Forests and 18 National Grasslands in 43 states and Puerto Rico. Each National Forest resource — timber, water, forage, fish and wildlife, and recreation — is managed to produce a harmonious environment along with tangible benefits for all of America's people.

Photo credits, Photographs of the Parson Capen, Henry Grady, Baldwin and Jonathan Ashley houses were loaned by the American Wood Council, Washington, D.C. Prints of the Fairbanks House, and the Marrs Log House were provided by the Library of Congress. Photograph of the Kiet Siel cliff dwellings is property of Laboratory of Tree-Ring Research, The University of Arizona. The National Maritime Museum, Stockholm, Sweden provided the photograph of the WASA. Photograph of subfloor decay on Page 8 was furnished by Small Homes Council, University of Illinois at Urbana-Champaign.

Rear cover photo: Front doorway to Jonathan Ashley House, Deerfield, Massachusetts, built in 1730.